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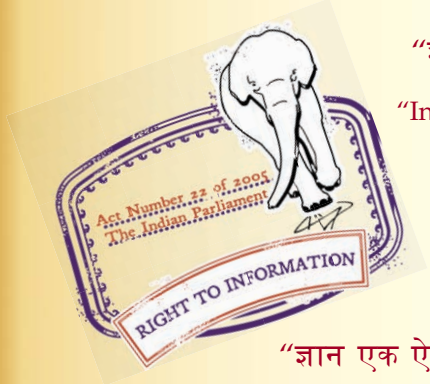
IS 12449-1 (1988): Starting Devices (Other than Glow Starters), Part 1: General and Safety Requirements [ETD 23: Electric Lamps and their Auxiliaries]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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Indian Standard

SPECIFICATION FOR STARTING DEVICES (OTHER THAN GLOW STARTERS)

PART 1 GENERAL AND SAFETY REQUIREMENTS

UDC 621·327·032·43

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 7

May 1989

AMENDMENT NO. 1 MAY 2002
TO
IS 12449(PART1):1988 SPECIFICATION FOR STARTING DEVICES (OTHER THAN GLOW STARTERS)

PART 1 GENERAL AND SAFETY REQUIREMENTS

(*Page* 2, *clause* 2.8, *line* 3) — Substitute the word 'produced' *for* 'generated'.

(*Page* 6, *clause* 13.0, *para* 2, *last sentence)*— Substitute the following for the existing sentence:

This requirement is complied with when, for preheated lamp electrodes, the preheating current has not increased more than 5 percent of the above value with starting devices short-circuited'

(*Page* 6, *clause* 13.0, *para* 3, *line* 2) — Substitute 13.1 to 134' *for* '13.1 to 13.5'.

(Page 6. *clause* 13.1. *para* 2, *line* 5) — Insert 'IS 5921 (Part 1): 1983' after the words 'specified in'.

(*Page* 6, *clause* 13.3, *para* 2, *line* 2)—Substitute 'Table 3' *for* 'Table 2'.

(*Page* 7, *clause* 13.5) — Delete the number '13.5' and read in continuation with the matter of clause 13.4 appearing on page 6.

(*Page* 7 *clause* 13.5, *para* 1, *last line*) — Substitute '13.1' to 13.4' for '13.2 to 13.6'.

(*Page* 7, *clause* 13.5. *para* 2, *line* 3) — Substitute '13.2 to 13.4' *for* '13.2 to 13.6'.

(*Page* 7, *clause* 13.5, *para* 3, *last line)*—Substitute '1 ohm' *for* '1Ω'.

(*Page* 8, *clouse* 15.1)—Insert the following Note at the end:

*NOTE — As in alternative to the electrostatic voltages prescribed in Fig. 1, a memory oscilloscope may be used in the circuit together wim a high voltage probe having the following properties:

Input resistance ≥ 100 Mohm
Input capacitance ≤ 15 pF
Cut off frequency ≥ 1MHZ

In case of doubt, the measurement with the electrostatic voltmeter shall be the reference method.'

[*Page* 8, *Figure* 2, *Sl No.* (b)(3)] — Substitute the range of static voltmeter '0 to 6 kV *for* '0 to 60 kV'.

[*Page* 8, *Figure* 2, *Sl No.*(b)(5)] — Substitute 'Short-circuit device for discharging HV capacitors' *for* 'Short circuiting device for discharging'.

(ET23)

Reprography Unit BIS. New Delhi. India

Indian Standard

SPECIFICATION FOR STARTING DEVICES (OTHER THAN GLOW STARTERS)

PART 1 GENERAL AND SAFETY REQUIREMENTS

0. FOREWORD

0.1 This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards on 24 June 1988, after the draft finalized by the Electric Lamps and Accessories Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard (Part 1) covers general and safety requirements for starting devices (other than glow starters) for tubular fluorescent and other discharge lamps. It covers starters (other than glow starters) and ignitors.

Performance requirements for these starting devices are covered in Part 2 of this standard.

NOTE — Safety requirements ensure that electrical equipment having been constructed in accordance with these requirements, does not endanger the safety of persons, domestic animals or property when properly installed, maintained and used in applications for which it was made.

0.3 This standard refers only to starting devices for use with ballasts and lamps which are used most commonly.

0.4 In preparing this standard, assistance has been derived from IEC draft 34C (Central Office) 152 Starting Devices (Other than Glow Starters), General and Safety Requirements.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard specifies general and safety requirements for starting devices (starters and ignitors) for tubular fluorescent and other discharge lamps for use on ac supplies up to 1000 V at 50 Hz which produce starting pulses not greater than 5 kV and which are used in combination with lamps and ballasts covered in IS : 2418 (Parts 1 and 2)-1977*, IS : 1534 (Part 1)-1977†, IS : 9974 (Parts 1 and 2)-1981‡, IS : 9900 (Parts 1 and 2)-1981§, and IS : 6616-1982‖.

1.2 It does not apply to flow starters or starting devices which are incorporated in discharge lamps or which are manually operated. Preheat transformers for flourescent lamps are not covered in this standard.

1.3 Requirements for starting devices producing pulses of more than 5 kV are under consideration.

NOTE — All glow starters for fluorescent and other discharge lamps including thermal relay/cut-outs will be included in IS : 2215-1984*.

*Tubular fluorescent lamps for general lighting service:
Part 1 Requirements and tests (*first revision*).
Part 2 Standard lamp data sheets (*first revision*).

†Ballasts for fluorescent lamps: Part 1 For switch start circuits (*second revision*)

‡High pressure sodium vapour lamps:
Part 1 General requirements and tests.
Part 2 Standard lamp data sheets.

§High pressure mercury vapour lamps:
Part 1 Requirements and tests.
Part 2 Standard lamp data sheets.

‖Ballasts for high pressure mercury vapour lamps (*first revision*).

2. DEFINITIONS

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Starting Device — Apparatus which provides, by itself or in combination with other components in the circuit, the appropriate electrical conditions needed to start a discharge type of lamp.

*Starters for fluorescent lamps (*third revision*).

2.1.1 *Independent Starting Device* — A starting device which is intended to be mounted separately outside a luminaire and without any additional enclosure.

2.1.2 *Built-in Starting Device* — A starting device consisting of one or more separate units, exclusively designed to be built into a luminaire, a box, an enclosure or the like.

2.2 Starter — A starting device, usually for fluorescent lamps, which provides for the necessary pre-heating of the electrodes and, in combination with the series impedance of the ballast, causes a surge in the voltage applied to the lamp.

NOTE — The starter element that releases the starting voltage pulse may be either triggered, for example, phase angle sychronized or non-triggered.

2.3 Ignitor — A starting device intended to generate voltage pulses to start discharge lamps and which does not provide for the pre-heating of electrodes.

NOTE — The element that releases the starting-voltage pulse may be either triggered or non-triggered.

2.4 Starting Devices with Operating Time Limitation — Starting devices which prevent prolonged attempts to start lamps which refuse to start, for example, lamps with de-activated electrodes.

NOTE — Prevention of starting attempts means that, in the case of starters, the starting current circuit is switched off and/or the current in the starting circuit is limited to a value equal to or smaller than the rated lamp current and significantly reducing the current flowing through the lamp.

In the case of ignitors, prevention of starting attempts means that pulse generation has ceased or voltage pulses are significantly reduced in amplitude.

2.5 Ballast — A unit inserted between the supply and one or more discharge lamps which, by means of inductance, capacitance or a combination of inductance and capacitance, serves mainly to limit the current of the (lamps) to the required value. The unit may consist of one or more separate components.

It may also include means for transforming the supply voltage and arrangements which help/ provide starting voltage, prevent cold starting, reduce stroboscopic effects, correct the power factor and/or suppress radio interference.

2.6 Supply Voltage — The voltage applied to the circuit in which the starting device operates.

2.7 Working Voltage — The highest rms voltage which may occur across any insulation, transients being neglected, in open-circuit conditions or during lamp operation, when the starting device is operated at its rated voltage.

2.8 Short-Circuit Power — The short-circuit power of a voltage source is the quotient of the square of the voltage to be generated at its output terminals (in open-circuit conditions) and the internal impedance of the source (as seen from the same terminals).

2.9 Live Part — A conductive part which may cause an electric shock in normal use. The neutral conductor is, however, regarded as a live part.

NOTE — The test to determine whether or not a conductive part is a live part which may cause an electric shock is given in Appendix A.

2.10 Rated Maximum Operating Temperature (of a Capacitor Case or of a Starting Device Case) (t_c) - The highest permissible temperature which may occur on the outer surface (at the indicated place, if marked) of the component under normal operating conditions at the rated voltage or maximum of the rated voltage range.

2.11 Rated Maximum Operating Temperature of a Winding (t_w) — The operating temperature of a ballast winding which gives expectancy of 10 years continuous service (at that temperature).

2.12 Type Test — A test or series of tests made on a type-test sample for the purpose of checking compliance of the design of a given product with the requirements of the relevant specification.

2.13 Type-Test Sample — A sample consisting of one or more similar units submitted by the manufacturer or responsible vendor for the purpose of a type test.

3. GENERAL REQUIREMENTS

3.1 Starting devices shall be so designed and constructed that in normal use they cause no danger to the user or surroundings.

3.2 In general, compliance is checked by carrying out all the tests specified.

In addition, the outer case of independent starting devices shall comply with requirements of IS : 10322 (Part 1)-1982* including classification and marketing requirements of that standard.

4. GENERAL NOTES ON TESTS

4.1 Tests in this standard are type tests.

4.2 The tests shall be carried out at an ambient temperature between 10 and 35'C, unless otherwise specified.

4.3 The tests shall be carried out in the order of the clauses of this specification, unless otherwise specified.

4.4 Starting devices, intended for use with lamps having different electrical characteristics, are tested with the lamp which gives the most unfavourable conditions.

*Specification for luminaires: Part 1 General requirements.

4.5 Three starting devices shall be submitted to all tests, unless otherwise specified.

4.6 If no specimen fails in the complete series of tests specified then starting devices of that type shall be "deemed to comply with this standard.

Starting devices are considered not to comply with this specification if there are more failures than that of one specimen in one of the tests. If one specimen fails in a test, that test and the preceding ones, which may have influenced the result of that test, are repeated on another set of specimens, all of which shall then comply with the repeated tests.

The applicant may submit, together with the first set of starting devices, the additional set which may be wanted, should one specimen fail. The testing station shall then, without further request, test the additional specimen and will only reject if a further failure occurs. If the additional set of specimens is not submitted at the same time, a failure of one sample will entail rejection.

5. CLASSIFICATION

5.1 Starting devices are classified according to method of installation:

a) independent starting devices, and

b) starting devices for building-in (built-in starting devices).

5.2 Classification should be supplemented with classification according to type of protection against electric shock (class 0, 1 and 2 devices) and with classification according to degree of protection against moisture together with the corresponding markings and test specifications (*see* IS : 10322*).

6. MARKING

6.1 Starting devices shall be clearly marked with the following mandatory marking, except when incorporated in a ballast.

a) Mark of origin (This may take the form of a trade-mark or the manufacturer's name or the name of the responsible vendor);

b) Manufacturer's model number or type reference;

c) Marking to show the peak value of the voltage produced, if the peak value exceeds 1·500 V. Connections carrying this voltage shall be marked as such;

d) Identification of terminals (by colour, letters, figures or the like); and

e) Symbol for an independent starting device, if applicable.

6.2 In addition to the above markings, the following information, if applicable, shall be given either on the starting device or be made available in the manufacturer's catalogue or the like.

a) Rated supply voltage (or voltages, if there are several) and frequency;

b) The lamp type and wattage or wattage range for which the starting device is suitable. Starting devices, where the lamp current flows through the device shall also indicate the maximum lamp current permitted;

c) In the case of built-in starting devices having no terminals, a clear indication shall be given on the wiring diagram of the significance of the code used for connecting wires. Starting devices that operate in specific circuits only shall be identified accordingly, for example, by marking or wiring diagram;

d) If starting devices are provided with time limitation, this shall be indicated;

e) The catalogue reference of the ballast, which may be associated with the starting device, if the ballast design governs the magnitude of the pulse voltage;

f) The value of t_c. If this relates to a certain place on the starting device, this place shall be indicated or specified in the manufacturer's catalogue;

g) The correlation between interchangeable parts of an ignitor and the ignitor itself shall be marked unambiguously by legends on the ignitor or specified in the manufacturer's catalogue;

h) Special conditions relating to the use of the starting device;

J) A declaration, if the starting device does not rely upon the luminaire enclosure for protection against accidental contact of live parts; and

k) A declaration of the cross-section of conductors for which the terminals, if any, are suitable.

6.2.1 The starting device may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised

*Specification for luminaires.

and supervised by BIS and operated by the producer Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6.3 Test of Marking — The durability of the marking shall be checked by trying to remove it by rubbing lightly for 15 s wtih a piece of cloth soaked with water and, after drying, for a further 15 s with a piece of cloth soaked with hexane. The marking shall be legible after the test.

7. PROTECTION AGAINST ACCIDENTAL CONTACT WITH LIVE PARTS

7.1 Starting devices which do not rely upon the luminaire enclosure for protection against electric shock [*see* 6.2(j)] shall be sufficiently protected against accidental contact with live parts, when installed as in normal use.

Lacquer or enamel is not deemed to be adequate protection or insulation for the purpose of this requirement.

Parts providing protection against accidental contact shall have adequate mechanical strength and shall not work loose in normal use. It shall not be possible to remove them without the use of tools.

Compliance shall be checked by inspection, and with regard to protection against accidental contact, by means of the test finger shown in Fig. 1 of IS: 302-1979* using an electrical indicator to show contact. This finger is applied in all possible positions, if necessary, with a force of of 10 N.

It is recommended that a lamp be used for the indication of contact and that the voltage be not less than 40 V.

7.2 Starting devices incorporating capacitors of total capacitance exceeding 05 μF, shall be constructed so that the voltage at the starting device terminations does not exeed 50 V, 1 min after disconnection of the starting device from a source of supply at rated voltage.

8. TERMINALS

8.1 Terminals shall comply with IS: 10322 (Part 3)-1984†.

9. PROVISION FOR EARTHING

9.1 Any earthing terminal shall comply with the requirements of **8**. The electrical connection shall be adequately locked against loosening and it shall not be possible to loosen the electrical connection by hand. For screwless terminals, it shall not be possible to loosen the electrical connection unintentionally.

9.2 Earthing of starting devices by means of fixing the starting devices to earthed metal is permitted. However, if a starting device has an earthing terminal, this terminal shall only be used for earthing the starting device.

All parts of an earth terminal shall be such as to minimize the danger of electrolytic corrosion resulting from contact with the earth conductor or any other metal in contact with them.

The screw or other parts of the earthing terminal shall be made of brass or other metal no less resistant to corrosion or a material with a non-rusting surface and at least one of the contact surfaces shall be bare metal.

9.3 Compliance shall be checked by inspection, by manual test and by tests referred under 8.

10. CONSTRUCTION

10.1 Wood, cotton, silk, paper and similar fibrous material shall not be used as insulation, unless impregnated.

Compliance shall be checked by inspection.

10.2 Printed circuits are permitted for internal connections.

Compliance shall be checked in connection with **13** of this standard.

10.3 All replaceable starting devices and accessible components of starting devices which may be replaced without tools shall have double insulation or reinforced insulation to be compatible with the insulation requirements of all classes of equipment including class II.

10.4 Starting devices equipped with cut-outs shall be of such a construction that, in case of non-igniting lamps, the cut-out interrupts the starting current circuit and/or the production of the starting voltage.

An alternative to a cut-out is permitted to be a device limiting the starting current and the production of starting voltage to such an extent that no current greater than 10 percent of the rated lamp current flows through the lamp, and further components in the overall lamp current circuit are not subjected to loads higher than the rated lamp current.

Compliance shall be checked in conjunction with **13** or **14**.

11. RESISTANCE TO DUST AND MOISTURE

11.1 Starting devices shall be proof against humid conditions which may occur in normal use.

Compliance shall be checked by the humidity treatment described in **11.2** followed immediately by the tests according to **12.1** and **12.2**.

*General and safety requirements for household and similar electrical appliances (*fifth revision*).

†Specification for luminaires: Part 3 Screw and screwless terminals.

Cable entries, if any, are left open and, if knock-outs are provided, one of them is opened.

Electrical components, enclosures and other parts which can be removed without the aid of a tool, are removed and subjected, if necessary, to the humidity treatment with main part.

11.2 The starting device is placed in the most unfavourable position of normal use, in a humidity cabinet containing air with a relative humidity maintained between 91 and 95 percent. The temperature of the air, at all places where devices can be located, is maintained within 1°C of any convenient value *T* between 20 and 30°C.

Before being placed in the humidity cabinet, the device is brought to a temperature between *T* and *T* + 4°*C.*

The device shall be kept in the cabinet for 48 h.

12. INSULATION RESISTANCE AND ELECTRIC STRENGTH

12.1 The insulation resistance and electric strength shall be adequate.

The compliance shall be checked by the following measurement of the insulation resistance and by the electric strength test or pulsing test according to 12.2.

Immediately after the moisture treatment, the insulation resistance shall be measured with adc voltage of approximately 500 V, the measurement being made 1 min after application of the voltage. The insulation resistance is measured between live parts and outer metal parts including fixing screws and a metal foil in contact with outer insulating parts.

The insulation resistance shall be not less than 2 *Mil.*

Care shall be taken to avoid the moisture of the devices at the end of the moisture treatment changing appreciably before the measurement of the insulation resistance.

To achieve this, it is recommended that the insulation resistance be measured while the devices are still kept in the moisture cabinet or in an adjacent room protected against draught and having similar conditions to those in the moisture cabinet.

12.2 The electric strength test or pulsing test is carried out between the same parts as stated in 12.1 immediately after the insulation resistance measurement.

For starting devices, which incorporate a high voltage winding, compliance shall be checked by the following pulsing test. The starting device shall be operated at 110 percent rated supply voltage without a lamp load until SO pulses have occurred, switching off and on the supply, if necessary.

NOTE — High-voltage winding denotes a winding incorporated in the starting device which produces the necessary voltage to start the lamp.

During the test, there shall be:

a) no visible or audible disruptive discharge (indication of failure of insulation under electrical stress);

b) no sparkover or flashover; and

c) no collapse or reduction of the front or the tail of the impulse voltage waveshape when observed on an oscilloscope.

For starting devices without a high voltage winding, compliance shall be checked by an electric strength test for 1 min.

The test voltage of substantially sine-wave form, having a frequency of SO Hz shall correspond to the values in Table I. Initially, not more than half the specified voltage shall be applied, the voltage shall then be raised rapidly to the prescribed value.

TABLE 1 ELECTRIC STRENGTH TEST VOLTAGE

WORKING VOLTAGE *(U)*	TEST VOLTAGB
(1)	(2)
Up to and including 42 V	500 V
Above 42 V and up to and including 1 000 V	*2U+* 1000V

No flashover or breakdown shall occur during the test.

The high voltage transformers used for the test designed that, when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 m A.

The overcurrent relay shall not trip when the output current is less than 100 m A.

Care shall be taken that the rms value of the test voltage applied is measured within ± 3 percent.

Care shall also be taken that the metal fcil is so placed that no flashover occurs at the edges of the insulation.

Glow discharges without drop in voltage are neglected.

13. FAULT CONDITIONS

13.0 When the starting device is operated under fault conditions, there shall be no emission of flames or molten metal, nor produce flammable gases and no accessible parts shall become live.

In addition, independent starting devices shall not exceed the temperature values for abnormal

operation in accordance with **14.3.** This requirement is regarded as complied with when, for preheated lamp electrodes, the preheating current has not increased more than 5 percent above the value under short-circuited starting device conditions.

Operation under fault conditions denotes that each of the conditions of **13.1** to **13.5** are applied in turn and, associated with them, those other fault conditions which are a logical consequence thereof with the provision that only one component at a time should be subject to a fault condition.

Examination of the apparatus and its circuit diagram will generally show the fault conditions which should be applied. These are applied in sequence in the order which is most convenient.

Totally enclosed starting devices shall not be opened for examination nor for the application of internal fault conditions, however, in case of doubt in conjunction with the examination of the circuit diagram, either the output terminals shall be short-circuited or, in agreement with the manufacturer, a specially prepared starting device shall be submitted for testing.

A device is considered to be totally enclosed if the components are so enclosed, for example, by encapsulation in a self-hardening compound bonded to the relevant surfaces that no clearances in air exist.

Components in which, according to the manufacturer's specifications, a short-circuit does not occur or which eliminate a short-circuit, shall not be bridged nor shall components in which, according to the manufacturer's specification, an open-circuit does not occur, be interrupted. The manufacturer shall show evidence that the components behave in the foreseen way, for example, by showing compliance with the relevant specification.

Mechanical cut-outs in starting devices shall be bridged if, with pre-heated lamp electrodes at 110 percent of rated voltage, the current through the ballast is more than 105 percent of the short-circuit value for a period longer than 5 min.

This requirement is regarded as being complied with when the mechanical cut-out meets the relevant conditions of IS : 3842 (Part 4)-1966*.

13.1 Short-circuit across creepage distances and clearances in air, if they are less than the values specified in 18, taking into account, however, any reduction allowed in **13.2** to **13.4**.

NOTE — Creepage distances and clearances below the values of 18 are not allowed between live parts and accessible metal parts.

*Electrical relays: Part 4 Thermal relays.

Between conductors, protected from surge energy from the supply (for example, a choke winding or a capacitor), which are on a printed board complying with pull-off and peel strength requirements specified in the creepage distance requirements are modified. The dimensions of Table 2 are replaced by the value calculated from the equation:

$$\log d = 0{\cdot}78 \log \frac{V}{300}, \text{ with a minimum of } 0{\cdot}5 \text{ mm}$$

where d is the distance in millimetres and V the peak value of the voltage in volts. In case of a non-sinusoidal starting voltage, the peak value of the working voltage is calculated by first dividing the maximum pulse height by the factor 46 and then multiplying by $\sqrt{2}$. These distances can be determined by reference to Fig. 1.

NOTE — Covering of lacquer or the like on printed boards is ignored, when calculating the distances.

TABLE 2 TORQUE TEST REQUIREMENTS FOR TERMINALS

(*Clauses* 13.1, 13.3 *and* 17.1)

NOMINAL DIAMETER OF SCREW mm	TORQUE Nm	
	I	II
Up to and including 2·8	0·2	0·4
Over 2·8 up to and including 3·0	0·25	0·5
Over 3·0 ,, ,, ,, ,, 3·2	0·3	0·6
Over 3·2 ,, ,, ,, ,, 3·6	0·4	0·8
Over 3·6 ,, ,, ,, ,, 4·1	0·7	1·2
Over 4·1 ,, ,, ,, ,, 4·7	0·8	1·8
Over 4·7 ,, ,, ,, ,, 5·3	0·8	2·0
Over 5·3 ,, ,, ,, 6·0	—	2·5

13.2 Short-circuit across or, if applicable, interruption of semiconductor devices.

Only one component at a time should be short-circuited (or interrupted).

13.3 Short-circuit across insulation consisting of covering of lacquer, enamel or textile.

Such coverings are ignored in assessing the creepage distances in air specified in Table 2.

However, if enamel forms the insulation of a wire and withstands the voltage test prescribed in IS : 4800*, it is considered as contributing 1 mm to those creepage distances and clearances in air.

This does not imply to short-circuit the insulation between turns of coils, insulating sleeves or tubings.

13.4 Short-circuit across electrolytic capacitors.

*Enamelled round winding wires.

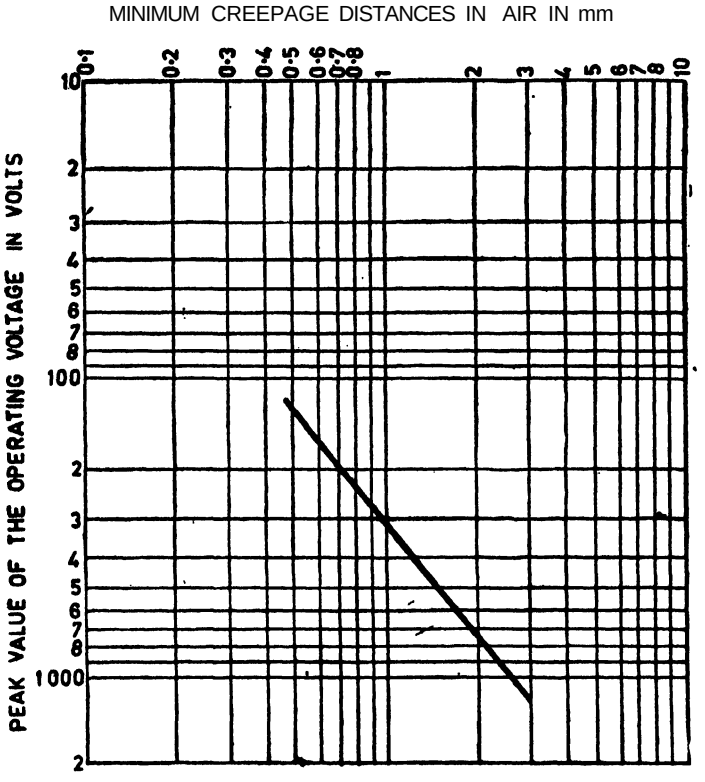


FIG. 1 MINIMUM CREEPAGE DISTANCES IN AIR

13.5 Compliance shall be checked by operating the starting device at maximum case temperature t_c and at any voltage between 0·9 and 1·1 times rated supply voltage with the lamp connected, under each of the fault conditions outlined in **13.2** to **13.6** inclusive, applied in turn.

The test shall be continued until stable conditions are obtained. When making the tests of **13.2** to **13.6** inclusive, components such as resistors, capacitors, fuses, etc, may fail. It is permitted to replace these components so as to continue the test.

After the test, when the starting devices have returned to ambient temperature, the insulation resistance measured at approximately 500 V dc shall be not less than 1Ω.

To check whether gases liberated from component parts are flammable or not, a test with a high-frequency spark generator shall be made.

To check whether accessible parts have become live, a test in accordance with Appendix A shall be made.

14. HEATING OF INDEPENDENT STARTING DEVICES

14.0 Independent starting devices shall not reach excessive temperatures during normal operation and abnormal operation.

Compliance shall be checked by the following tests.

14.1 Normal conditions are working conditions in which one or more of the following apply:

a) When the lamps are operating normally;

b) When the rated current flows through the starting device;

c) When the starting device has been connected to a voltage source, for example, the mains voltage or the lamp voltage arising during normal operation; and

d) A combination of (b) and (c).

The tests shall be carried out in a draught free room or enclosure (*see* Appendix B).

Independent starting devices shall be mounted in a test corner consisting of three matt black painted boards 15-25 mm thick and arranged so as to imitate two walls and the ceiling of a room. The starting device is secured to the ceiling as close as possible to the walls, the ceiling extending at least 250 mm beyond the other sides of the starting device.

14.2 Normal Operation — The starting devices shall be connected as for normal use with appropriate lamps.

When the lamp is in stable operation, the lamp current shall be set for the rated value by

modifying the voltage applied. In this condition, the starting devices and lamps shall be operated until they reach steady temperature.

The temperatures of the components shall not exceed the values specified in 6 of IS : 10322 (Part 4)-1984*.

The ballast employed shall meet the requirements of the relevant Indian standard and be compatible with the lamp type to be started by the starting device.

14.3 Abnormal Operation — Starters shall be connected as for normal use with appropriate lamps. The test is made with lamps having de-activated cathodes or substitution resistors specified in IS : 2418 (Part 2)-1977†. A lamp of the highest watt rating for which the starter is suitable and an appropriate ballast shall be used.

Ignitors are connected as for appropriate use, however, without lamp.

In the case of abnormal conditions, the ignitors are operated at 110 percent of the rated supply voltage until they reach the steady temperature. After this the temperature of the components shall be determined. Temperatures shall not exceed the values specified in IS : 10322 (Part 4)-1984*.

14.4 After these heating tests and after cooling down, the starting device shall comply with the following conditions:

a) Starting device marking shall still be legible; and

b) Starting device shall withstand without damage a voltage test according to 12.2, the test voltage, however, being reduced to 75 percent of the values given in Table 1 but not less than 500 V.

15. PULSE VOLTAGE (OF IGNITORS)

15.1 The maximum value of the pulse voltage shall not exceed 5 kV when operated at the rated supply voltage and with a load capacitance of 20 pF, using the circuit shown in Fig. 2 for either positive or negative pulses, taking into account, however, the maximum pulse voltage specified in relevant lamp data sheet.

16. MECHANICAL STRENGTH

16.1 Replaceable starting devices and accessible components of starting devices which may be replaced without tools shall have sufficient mechanical strength.

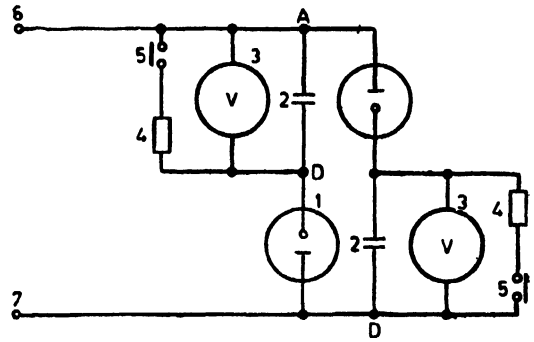
a) Starting devices and components up to 100 grams and all starters in the external dimensions specified in IS : 2215-1984‡ shall be subjected to the tumbling barrel test in accordance with Appendix C. Each sample shall withstand 20 falls without damage affecting safety.

b) Starting devices and components over 100 grams shall be subjected to the spring hammer test in accordance with Appendix C. The impact energy and spring compression of the testing apparatus shall be 0.35 Nm and 17 mm respectively.

After the test, the sample shall show no damage impairing safety.

*Specification for luminaires: Part 4 Methods of tests.
†Standard lamp data sheets (*first revision*).
‡Starters for fluorescent lamps (*third revision*).

a) Circuit



b) Components

1. *HV diode*

Blocking voltage	U_{RM} > 25 kV
Rated current	$I_{FAvm} \geq$ 1·5 mA
Periodical peak current	$I_{FRM} \geq$ 0·1 A
Anode/cathode capacitance	$C_a/k \leq$ 2 pF

NOTE— Suitable parts are for example rectifire tubes, type GY 501 CTV receivers.

2. *HV capacitor*

Capacitance	C = 500 pF
Rated voltage	U > 6·3 kV
Phaser-angle difference (at 10 kHz)	tan ^{3} 20 × 10^{-2}

3. *HV measuring instrument*

Static voltmeter	0 to 60 kV
Capacitance at full deflection	< 15 pF
Breakdown voltage	> 10 kV
Precision	Class 1 or better

4. *Discharge resistance* IMΩ
5. *short-circuiting device for discharging*
6. *To high voltage lead of ignitor*
7. *To neutral conductor*

NOTE — The leakage resistance between A and B, and between C and D shall not be less than 10^{12} ohms.

FIG. 2 STARTING VOLTAGE MEASUREMENT FOR IGNITORS

16.2 Replaceable starting devices and accessible components of starting devices which may be replaced without tools, but which are subject to a turning moment during normal insertion, shall withstand a torque test of 0·6 Nm about the axes.

The torque is applied at the canister top. The contact pins are clamped tight and the torque is gradually increased from zero to the value required.

After the test, the sample shall show no damage impairing safety.

17. SCREWS, CURRENT CARRYING PARTS AND CONNECTIONS

17.1 Screwed connections, electrical or otherwise, the failure of which might cause the starting device to become unsafe, shall withstand the mechanical stresses occurring in normal use.

Screws transmitting contact pressure, which have a nominal diameter less than 3 mm shall screw into metal.

Compliance shall be checked by inspection, and for screws and nuts transmitting contact pressure by the following tests.

The screws or nuts are tightened or loosened:

a) ten times for screws in engagement with a thread of insulating material, and

b) five times for nuts or other screws.

Screws in engagement with a thread of insulating material are completely removed and reinserted each time.

When testing terminal screws and nuts, a solid conductor of the largest cross-section specified in **8.1** is placed in the terminal. The tot is made by means of a suitable test screwdriver or spanner applying a torque as shown in Table 2, column 1 applies to screws without heads if the screws, when tightened, does not protrude from the hole. Column 2 applies to other screws and to nuts.

The conductor is moved each time the screw or nut is loosened.

During the test, no damage impairing the future use of screwed connections shall occur.

Screws which may be operated when connections are made to the starting device include, for example, terminal screws, screws for fixing covers when they have to be loosened to open the starting device, etc. Conduit thread connections and screws to fasten the starting device to their supports are excluded.

The shape of the blade of the test screwdriver shall match the slot of the screw to be tested. The screw shall not be tightened in jerks. Nuts are tested in a similar manner. Damage to covers is neglected.

17.2 Screws in engagement with a thread of insulating material shall have a length of engagement of at least 3 mm plus one third of the nominal screw diameter, except that this length need not exceed 8 mm. Correct introduction of the screw into the screw hole or nut shall be ensured.

Compliance shall be checked by inspection, by measurement and by manual test.

The requirement with regard to correct introduction is met if introduction of the screw in a slanting manner is prevented, for example, by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with the leading thread removed.

17.3 Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resiliency in the metal parts to compensate for any possible shrinkage of the insulating material.

This requirement does not apply to contacts between interchangeable parts, for example, starting device and starter holder.

This requires an adequate spring action in the holder.

Compliance shall be checked by inspection and a manual test.

17.4 Space threaded screws shall not be used for the connection of current-carrying parts, unless they press these parts directly and conductively together, and unless they are locked against loosening by suitable means.

Thread-cutting screws may be used for the interconnection of current-carrying parts which do not consist of soft materials liable to yield, such as zinc or aluminium.

Space threaded screws may be used for earth continuity connections which need not be disassembled during the intended use. At least two equivalent screws should then be used which are adequately protected against loosening.

Compliance shall be checked by inspection.

17.5 Screws and rivets which serve as electrical as well as mechanical connections shall be locked against loosening.

Compliance shall be checked by inspection and by manual test.

Spring washers may provide satisfactory locking. For rivets, a non-circular shank or an appropriate notch may be sufficient.

Sealing compound which softens on heating provide satisfactory locking only for screw connections not subject to torsion in normal use.

17.6 Current-carrying parts shall be of copper, an alloy containing at least SO percent copper or other metal no less resistant to corrosion than copper and having mechanical properties no less suitable.

Compliance shall be checked by inspection.

The requirements do not apply to screws which do not essentially carry current such as terminal screws.

18. CREEP AGE DISTANCES AND CLEARANCES

18.1 Creepage distances and clearances shall not be less than the values in Table 3.

TABLE 3 CREEPAGE DISTANCES AND CLEARANCES IN AIR

DISTANCE*	WORKING VOLTAGE OR STARTING VOLTAGE OF STARTING DEVICE†		STARTING DEVICES OTHER THAN THOSE ACCORDING TO 10.3	REPLACEABLE STARTING DEVICES ACCORDING TO 10.3‡
	Starting Voltage Non-Sinusoidal V peak	Starting Voltage or Working Voltage Sinewave Form V rms	mm	mm
(1)	(2)	(3)	(4)	(5)
Between live parts of different polarity	Up to and including 1 150	Up to and including 250	3(2)	3
	Over 1 150 to 2 300	Over 250 to 500	4(2)	4
	Over 2 300 to 3 450	Over 500 to 750	5(3)	5
	Over 3 450 to 5 000	Over 750 to 1 000	6(4)	6
Between live parts and accessible metal parts as well as outer accessible surfaces of pans of insulating material§	Up to and including 1 150	Up to and including 250	4(2)	8
	Overl 150 to 2 300	Over 250 to 500	5(3)	10
	Over 2 300 to 3 450	Over 500 to 750	6(4)	12
	Over 3 450 to 5 000	Over 750 to 1000	6(4)	12
Between parts which can be live in the event of failure in the basic insulation of a starting device and accessible metal parts	Up to and including 1 150	Up to and including 250		4
	Over 1150 to 2 300	Over 250 to 500		5
	Over 2 300 to 3 450	Over 500 to 750		6
	Over 3 450 to 5 000	Over 750 to 1 000		6

NOTE 1 — Creepage distances are distances in air measured along with surface of insulation.

A metal enclosure shall have an insulating lining, if in the absence of such a lining, the creepage distance of clearances between live parts and the enclosure would be smaller than the values prescribed above.

NOTE 2 — The working voltage for determining the creepage distances and clearances in this table is calculated as follows:

$$U_R = \frac{U_s}{4{\cdot}6}$$

where

U_R = rms value of the working voltage according to this table, and

U_s = peak value of the starting voltage of the device at rated voltage.

The reduction factor 4·6 only applies to those pulse voltages, U_s which are the basis for the calculation of creepage distances and clearances having a pulse width of not more than 2 milliseconds. The pulse width shall be measured at the value of the peak voltage divided by 4·6 (*see* Fig. 3).

For values from 1 000 V up to 1 087 V, a working voltage of 1 000 V has been taken as basis for determining the creepage of distances and clearances.

*Distances from live parts which, during the starting of the lamp or during abnormal operation (fault conditions), are subject to voltages within the limits indicated in the table.

†The starting voltage is measured both in the measuring circuit in accordance with Fig. 2, with parallel capacitor, for determining the non-sinusoidal voltage value, and on an electrostatic rms meter, for determining the rms voltage value. The largest distance resulting from the measured values applies.

‡The creepage distances and clearances specified in this clause do not apply to starting devices which comply with the dimensions specified in IS : 2215-1984 "Starters for fluorescent lamps (*third revision*)'. In such instances, the requirements of that standard shall apply.

The values in brackets apply to creepage distances and clearances where the surface area is not liable to contamination by dust or moisture.

Starting devices, where the components are so enclosed, for example, by encapsulation in a self-hardening compound bonded to the relevant surfaces that no clearances in air exist, are not checked.

Printed boards are exempt from the requirements of 18 because they are tested according to 13.

The contribution to the creepage distance of any groove less than 1 mm wide shall be limited to its width.

Any air-gap of less than 1 mm shall be ignored in computing the total air path.

§Accessible metal parts are rigidly placed in relation to live parts.

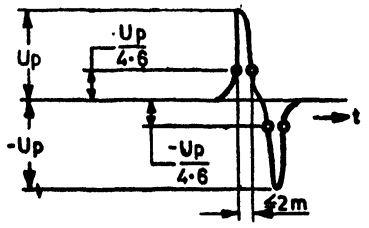


FIG. 3 DETERMINATION OF PULSE WIDTH

19. RESISTANCE TO HEAT, FIRE AND TRACKING

19.1 Starting devices shall be sufficiently resistant to heat External parts of insulating material providing protection against electric shock and parts of insulating material retaining live parts in position shall be sufficiently resistant to heat.

For materials other than ceramic, compliance shall be checked by subjecting the parts to the ball-pressure test according to IS: 10322 (Part 4). 1984*.

19.2 External parts of insulating material providing protection against electric shock and parts of insulating material retaining live parts in position shall be sufficiently resistant to flame and ignition.

For materials other than ceramic, compliance shall be checked by the tests of **19.3** and **19.4.**

However, printed boards are not tested as above, but shall be tested according to IS: 5921 (Part 1)-1983†.

19.3 External parts of insulating material providing protection against electric shock shall be subjected to the glow-wire test in accordance with IS : 11000 (Part 2/Sec 1)-1984‡ subject to the following details:

a) Test sample shall be one specimen,

b) Test specimen shall be a complete component, and

c) Temperature of the tip of the glow-wire shall be 650°C

19.4 Parts of insulating material retaining live parts in position shall be subjected to the needle flame test in accordance with IS ; 11000 (Part 2/ Sec 2)-1984‡ subject to the following details:

a) Test sample shall be one specimen;

b) Test specimen shall be a complete component. If it is necessary to take away parts of the starting device to perform the test, care shall be taken to ensure that the test conditions are not significantly different from those occurring in normal use;

c) Test flame shall be applied to the centre of the surface to be tested;

d) Duration of application shall be 10 s; and

e) Any self-sustaining flame shall extinguish within 30 s of removal of the gas flame and any flaming drops shall not ignite a piece of tissue paper spread out horizontally 200 mm below the test specimen.

19.5 Starting devices intended for building into luminaires other than ordinary, independent starting devices having insulation subject to starting voltages with a peak value higher than 1 500 V, shall be resistant to tracking.

For materials other than ceramic, compliance shall be checked by subjecting the parts to the tracking test according to IS : 10322 (Part 4)-1984*.

20. RESISTANCE TO CORROSION

20.1 Ferrous parts, the rusting of which may endanger the safety of the starting device, shall be adequately rust-protected. This requirement applies to the outer surface of iron cores.

Compliance shall be checked by the following test.

All grease shall be removed from the parts to be tested by immersion in a suitable degreasing agent for 10 minutes.

The parts shall then be immersed for 10 minutes in 10 percent solution of ammonium chloride in water at a temperature of 20 ± 5°C.

Without drying, but after shaking off any drops of water, the parts shall be placed for 10 minutes in a box containing air saturated with moisture at a temperature of 20 ± 5°C.

After the parts have been dried for 10 minutes in a heating cabinet at a temperature of 100 ± 5°C, their surfaces shall show no sign of rust. Traces of rust on any sharp edge and any yellowish film removable by rubbing are ignored.

Protection by varnish is deemed to be adequate for the outer surface of iron cores.

*Specification for luminaircs: Part 4 Methods of tests.

†Metal-clad base material for printed circuits for use in electronic and telecommunication equipment: Part 1 General requirements and tests.

(Fire hazard testing: Part 2 Test methods, Section 1 Glow-wire test and guidance, and Section 2 Needle-flame test.

*Specification for luminaires: Part 4 Methods of tests.

APPENDIX A

(*Clauses* 2.9 *and* 13.5)

TEST TO ESTABLISH WHETHER A CONDUCTIVE PART IS A LIVE PART WHICH MAY CAUSE AN ELECTRIC SHOCK

A-l. In order to determine whether a conductive part is a live part which may cause an electric shock, the starting device is operated at design voltage and nominal frequency, and the following tests shall be conducted.

A-1.1 The current flowing between the part concerned and earth is measured, the measuring circuit having a non-inductive resistance of 2 000 ± 50Ω. The part concerned is a live part if a current of more than 0·7 mA (peak) or 2 mA dc is measured.

A-1.2 For frequencies above 1 kHz, the limit of 0·7 mA (peak) is multiplied by the value of the frequency in kHz, but shall not exceed 70 mA (peak).

The voltage between the part concerned and any accessible part is measured, the measuring circuit having a non-inductive resistance of S50 000Ω. The part concerned is a live part if a voltage of more than 34 V (peak) is measured.

For the above test, one pole of the test supply shall be at earth potential.

APPENDIX B

(*Clause* 14.1)

DRAUGHT-PROOF ENCLOSURE

B-l. The following recommendations refer to the construction and use of a suitable draught-proof enclosure as required for the heating tests of independent starting devices. Alternative constructions for draught-proof enclosures are permitted if it is established that similar results are obtained.

B-2. The draught-proof enclosure is rectangular, with a double skin on top and at least three sides, and with a solid base. The double skins are of perforated metal, spaced apart approximately 150 mm, with regular perforations of 1 to 2 mm diameter occupying about 40 percent of the whole area of each skin.

B-3. The internal surfaces are painted with a matt paint. The three principal internal dimensions are each at least 900 mm. There should be a clearance of at least 200 mm between the internal surfaces, and the top and four sides of the largest device for which the enclosure is designed.

NOTE — If it is required to test two or more devices in a large enclosure, care should be taken that radiation from one device cannot affect any other.

B-4. There is a clearance of at least 300 mm above the top of the enclosure and around the perforated sides. The enclosure is at a location protected as far as possible from draughts and sudden changes in air temperature; it is also to be protected from sources of radiant heat.

B-5. A device under test is positioned as far away as possible from the five internal surfaces of the enclosure, the device being supported as required by **14**.

APPENDIX C

(*Clause* 16.1)

MECHANICAL STRENGTH TESTING

C-l. Replaceable starting devices and accessible components over 100 g mass shall be tested as follows.

Blows are applied to the part under test by means of the spring-operated impact test apparatus shown in Fig. 4.

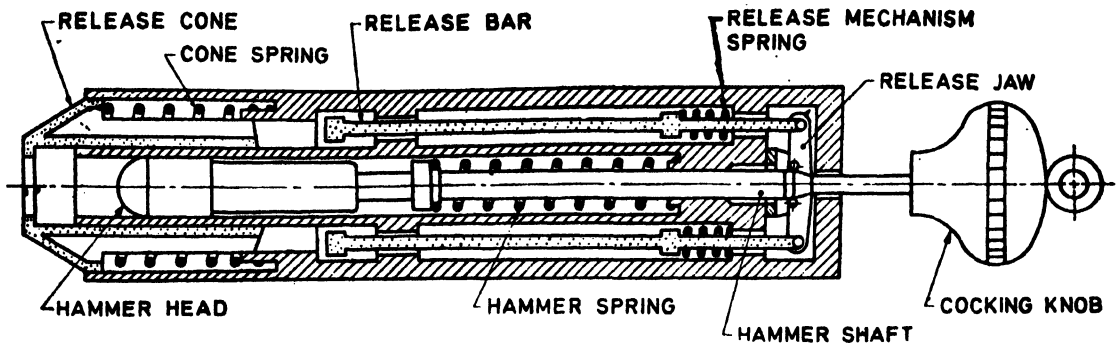


FIG. 4 IMPACT TEST APPARATUS

The apparatus consists of three main parts, the body, the striking element and the spring-loaded release cone.

The body comprises the housing, the striking element guide, the release mechanism and all parts rigidly fixed thereto. The mass of the assembly is 1 250 g.

The striking element comprises the hammer head, the hammer shaft and the cocking knob. The mass of this assembly is 250 g. The hammer head has a hemispherical base of polyamide, having a Rockwell hardness of R 100, with a radius of 10 mm; it is fixed to the hammer shaft in such a way that the distance from its tip to the plane of the front of the cone, when the striking element is on the point of release, is equal to the value specified for compression in 16.1.

After adjustment, the configuration of the hammer shaft, hammer head and hammer spring adjustment nuts shall be such that the hammer spring has released all its stored energy approximately 1 mm before the tip of the hammer head passes the plane of impact. Thus for the last 1 mm of its travel, the striking element is, other than for friction, a freely moving projectile, with all its potential energy converted to kinetic energy. Furthermore, the striking element shall after passing the plane of impact be free to over-run without interference for not less than 8 mm.

The cone has a mass of 60 g and the cone spring exerts a force of about 5 N, and the release jaws exert a force of about 5 N so that the tripping force exerted when the jaws release the striking element does not exceed 10 N.

An impact test apparatus is used which is adjusted so that the test apparatus *is* being held in a horizontal position. The kinetic energy of the striking element just before the impact has the value specified in **16.1**.

NOTE — In order to avoid frequent calibration, it is recommended to use a separate test apparatus for each value of impact energy.

The release mechanism springs are adjusted so that they exert just sufficient pressure to keep the release jaws in the engaged position.

The apparatus is cocked by pulling the cocking knob back until the release jaws engage with the groove in the hammer shaft.

The blows are applied by positioning the release cone against the sample in a direction perpendicular to the surface at the point to be tested.

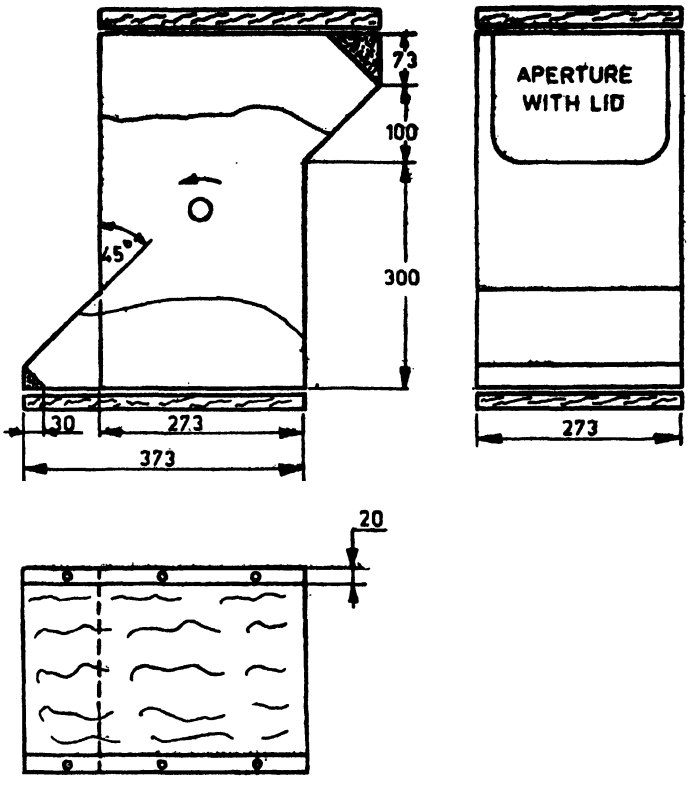
The pressure is slowly increased so that the cone moves back until it is in contact with the release bars, which is then moved to operate the release mechanism and allow the hammer to strike. The sample is rigidly supported, cable entries being left open, knock-outs opened, and cover fitting and similar screws tightened with a torque equal to two-thirds of that specified in 17.5

Three blows are applied to every point that is likely to be weak, paying special regard to insulating material enclosing live parts and to bushings of insulating material, if any. After these tests, the sample shall show no damage within the meaning of the specification.

Damage to paint and small dents which do not influence creepage distances or clearances are neglected. There shall not be any decrease in the resistance to the ingress of moisture.

C-2. Replaceable starting devices and accessible components up to 100 g mass shall be tested as follows:

The parts to be tested are subjected to 20 falls of 500 mm onto a 3 mm thick steel plate in a tumbling barrel turning at 5 rev/min (that is, 10 falls per minute). Suitable equipment for this test is shown in Fig. 5.



All dimensions in millimetres.

FIG. 5 TUMBLING BARREL

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